DOCUMENT RESUME

ED 137 674 CG 011 260

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TITLE Some Human Factors Issues in Bringing Jobs to Confined Persons.
PUB DATE 3 Sep 76
NOTE 27p.; Paper presented at the Annual Convention of the American Psychological Association (84th, Washington, D.C., September 3-7, 1976)

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS Daily Living Skills; Engineering Technology; *Handicapped; *Human Dignity; *Human Engineering; Information Networks; *Normalization (Handicapped); Physical Design Needs; Sensory Deprivation; State of the Art Reviews; *Telecommunication

ABSTRACT

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FIRST DRAFT

There are some bibliographic errors in this paper. Attention on next page

SOME HUMAN FACTORS ISSUES IN BRINGING JOBS TO CONFINED PERSONS

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for

American Psychological Association

Convention

Division 21

Washington, D.C.

September 3, 1976

CG011260

The author has been reinforced and encouraged in these explorations by the insights and efforts of Tom Shworles, Director, Center for Program Development and the Handicapped, City Colleges of Chicago; by the tolerance shown by his family and Susan of his sometimes unusual work patterns; and by two small grants--one in 1973 from Western Electric to support a three-day multidisciplinary conference on the idea of bringing jobs to the disabled via computer-telecommunications technology; a second in 1975 by Bell Northern Research (Canada) to do a mini-technology assessment on TOPS (a new piece telephone operator equipment) as a remote employment option for disabled persons.

ABSTRACT

This paper explores several human factors and other issues associated with taking jobs to disabled persons using computer-telecommunications technology and systems. General concepts of the transportation communications tradeoff are discussed. Legal and institutional dimensions of handicapped employments are addressed. A variety of research and application needs, with a human factors emphasis, are suggested. A 65-item bibliography is included.

Introduction

The title of my paper leaves me with considerable room for taking my presentation in directions where I feel most comfortable. I will discuss "some" human factors issues in bringing jobs to confined persons--but this discussion will be carried out with certain constraints so as to limit the scope.

The idea of "bringing jobs to confined persons" is imbedded in a broader area of contemporary interest which I call the "transportation-communication trade off" relative to the ways we organize work in our technological society (Overby, 1974 & 1975). Thus my focus will be confined to jobs of an information handling character involving present and emerging computer-telecommunications technology and related work systems.

The notion of "confined persons" will be restricted to persons who find themselves confined by virtue of physical disabilities which severely restrict personal travel (Overby, Hutchison & Wierzinski, 1974).

My purpose with this paper is to suggest areas in which human factors or engineering psychologist specialists might explore so as to make substantive contributions toward the creation and implementation of new gainful employment opportunities for severely disabled persons in information handling work.

Some Dimensions of the Need for Employment Enhancement for the Disabled

Definitions of the term "handicapped" or "disabled" are not clean cut and precise. Special definitional problems arise in connection with the term "severely handicapped" to whom attention was given in PL 93-112. See the July/August 1976 issue of The Journal of Rehabilitation. To gain some insight into several dimensions of the problem, however, the following statistical summaries were taken from (PCEH, 1970).

The 1970 Census showed a total of 121,000,000 noninstitutionalized, nonmilitary, male and female adults (ages 16-64) in the U.S. population. There were 11,265,000 persons in the same age range (noninstitutionalized) with disabilities which existed for six months or longer. Thus, in this working age range, one in every eleven Americans, over nine percent, were handicapped in some way.

In terms of 1969 income, 42 percent of total adult males earned less than $5,000 per year, whereas 56 percent of handicapped adult males earned less than $5,000.

Comparing employment rates, 76 percent of all males as contrasted to 58 percent of handicapped males, and 42 percent of all women as contrasted to 24 percent of handicapped women are employed.

Disability increases with age. Percent of male and female disabled as a function of age is as follows: Age 16-24 (4.5%), 25-34 (5.0%), 35-44 (7.6%), 45-54 (12.7%) and age 55-64 (21.0%).

(Desautels, 1973) drawing from 1957-58 statistical data classified the principle disabilities as shown in Table I.

Type of Impairment	Ave. No. (1000)	%	Rate/ 1000
All impairments	23,815	100.0	141.4
Blindness	960	4.0	5.7
Other visual impairments	2,064	8.7	12.3
Hearing impairments	5,822	24.4	34.6
Speech defects	1,098	4.6	6.5
Paralysis	940	3.9	5.6
Absence of fingers or toes	1,428	6.0	8.5
Absence of major extremities	282	1.2	1.7
Impairment of extremities	4,836	20.3	28.7
Impairment, except extremities	5,026	21.1	29.9
All other impairments	1,359	5.7	8.1

Table I. Number of impairments, percent distribution and rate per 1000 persons by type of impairment: U.S. 1957-58 (ignoring multiple handicaps).

Thus, the magnitude of numbers of disabled, their lower earnings and lesser participation in the labor force indicate some reasons for our consideration of the problem/possibilities of taking jobs to the handicapped.

Transportation-Communication Trade-Off and Work Organization

It is a thesis of this paper that we in the technologically advanced societies are in and steadily moving further into what some have called the "Information Era." Computer-telecommunication technology and its proliferation of applications have implications for the ways we organize ourselves to perform our work functions.

The basic structures of human societies are intimately related to the technology of travel and communication. Indeed (Van Vleck, 1974) suggests that society has been defined as "an enduring and cooperating social group whose members have developed organized patterns of relationships through interaction with one another." In the development from primitive to modern complex societies of today, transportation and communication technology are simply the technological extensions of locomotion and speech which, in part, have been instrumental in the societal development process.

Since transportation and communication are such intimately related to, and basic extensions of, human functions, it is unfortunate that in some ways we are not yet adequately treating them as synergistic systems. Several authors point out that in urban planning, for example, transportation is a major factor, but telecommunications seldom enters the planning picture as an interacting variable (Harkness, 1972; Reid, 1971).

Industrial engineers, human factors and organizational specialists, managements and many others have long been interested and involved in the design and organization of work. The activities of F. W. Taylor and the Gilbreths at the turn of the century in the United States are illustrative of early industrial engineering interest. Their work represents a kind of watershed in the process of industrialization, when rational analysis and synthesis was purposefully applied to human work in order to optimize in terms of efficiency and fatigue as these terms were understood in their day.

One basic assumption thoroughly explicit and implicit in all of our designs of work is that which leads us to transport people to work rather than work to people.

Present patterns of work organization resulted in many ways from technological changes associated with the industrial revolution when the organization of work shifted from "cottage industry" to the "factory system" (Ashton, 1961; Smith, 1937). In the intervening 150-200 years, the basic concepts of work organization in all of our institutions have been influenced by the technology and economies of an earlier era which implies that persons move to centralized work centers to perform their functions.

Meanwhile, a revolution has been taking place in the technology of communication, computing and information processing. Increasing numbers of people in all institutions are engaged in information processing rather than in the processing of physical materials. The U.S. Department of Labor's Manpower Administration (GPO, 1974) indicates that by 1977 over fifty percent of the U.S. labor force will be employed in white collar jobs. In 1960 some 43.1 percent of the work force held white collar jobs. By 1980 it is estimated that 51.5 percent will be so employed. The proportion in blue collar jobs has been slowly and steadily declining from 36.3 percent in 1960 to an estimated 33.1 percent by 1980. All manufacturing, commercial or service organizations have expanding office work forces for whom the major "raw material" is information in oral, written, pictorial, graphical, or numerical form. Some enterprises such as insurance, banking and many governmental functions are almost "pure" information processing institutions with literally all employees engaged in the acquisition and processing of information and associated decision making. Perhaps it is time that we address ourselves to new patterns of work organization consistent with our present and emerging information technology capabilities.

As our society evolves and becomes more complex, and as we consume our resources at an exponential rate, we become confronted with "limits to exponential growth" and some of the consequences of such growth (Meadows et al., 1972; Daedalus, 1974 & Keyfitz, 1976). Growth of automobile transport, consumption of fuels, associated pollution, traffic congestion and accidents are illustrative of these problems. Transportation of human beings produces contact that enables communication, which in turn aids in carrying out the functions and purposes of society. Confronted with physical and human ecological and resource limitations, perhaps we should

creatively consider, propose, experiment with, and evaluate some alternatives to people transport--namely substitutions in the form of communications technology. Several possibilities inherent in these considerations might enable us to meet our needs with a reduction in some of the external diseconomies associated with present predominant forms of personal travel and thus lead to improvements in the quality of life.

In recent years and especially since the energy crunch of 1973, there has been an increasing crescendo of interest in the transportation communication tradeoff. For additional readings in this area see (Day, 1974; Dickson, 1973; Goldmark, 1972; Krzyczkowski, 1974; Lathey, 1975; Mackness, 1972; Overby, 1974; Reid, 1971; Tyler, 1974; Vachon, 1975, Van Vleck, 1974). The work of J. Nilles and colleagues at the University of Southern California, and de Sola Pool at MIT should be of interest. Especially helpful should be the extensive assessment of the transportation-communication tradeoff presently being completed under an NSF grant by Roger Hough and colleagues at the Stanford Research Institute. For a look at some human factors issues in the transportation-communication tradeoff see (Klemmer, 1973) and in general the work of Champness, Christie, Elton, Short and Williams and associates at the Communications Studies Group, University College in London.

Important as the above concerns are, there is another compelling reason for exploring the "transportation-communication tradeoff" and "new patterns of work organization" inherent therein--namely the possibility of opening up new employment opportunities for homebound persons. Homebound may be defined broadly to include those such as business and engineering executives, and women who choose to work at home (Deming, Datamation, 1974; Lape, 1970) and those who are forced to remain at home because of physical disabilities which limit travel. Home employment trends arising from personal choice should be explored for insights as to possibilities for those who are forced to remain confined.

Socio-Technical Human Factors Systems

I first became involved in this area some five years ago (Overby, 1973). As my interest has continued and because I have an application and implementation orientation (arising out of my engineering roots), I have increasingly become aware of broad categories of restrictions to implementation which I have come to call "institutional and behavioral" constraints. If there is merit in pursuing these ideas (I think there is) and if we wish to move toward implementation (including detailed human factors contributions) then it behooves us to examine and understand in some detail several of these institutional and behavioral factors. In fact were I to rank order institutional factors and detailed human-machine factors in terms of importance from an implementation point of view, institutional factors would loom first. Since I assume a rather broad view of human factors concerns, I can easily include institutional parameters as part of the legitimate territory of human factors or engineering psychology specialists--let's call it sociotechnical human factors systems.

Let me give you a specific instance of what I mean by institutional dimensions of the problem. In 1971, when I first became interested in the problems and possibilities of taking information jobs to people rather than people to these jobs, there was not too much visible activity in the land relative to rehabilitation and employment for the most severely disabled among us. By 1973, this was changed. The United States Congress passed a law, PL 93-112, the "Rehabilitation Act of 1973." This act in several places emphasized the need to do something positive with the severely disabled population. Section 503 of the act requires that all companies with annual federal contracts greater than $2,500 shall take affirmative action to employ and advance in employment of qualified handicapped individuals as defined by section 7(6) of the law. The Department of HEW just recently issued a notice of intent to publish proposed regulations affecting section 504, nondiscrimination on the basis of handicap (Federal Register, Vol. 41, No. 96, dated May 17, 1976).

My point in the above is simply to note that with this law all kinds of institutional arrangements have been changed such that the promise of employment for disabled persons takes on new reality. We are now in a new milieu which (depending on how the law is implemented) captures the interest of many disciplines that formerly had but limited involvement in the employment of the disabled. Thus industrial engineers are writing about the IE's role in job analysis and adaptation to more easily accommodate handicapped persons (Deane, 1975). Psychologists are discussing new personnel responsibilities for rehabilitation professionals (Berger, et al., 1975).

In short, we seem to be in a new "ball game" relative to the topic of this paper. It remains a research question, in my opinion amenable to the human factors discipline, to seek to understand the implications of this law for homebound employment of severel, disabled persons in information handling work.

For additional recent discussion of this law and some of its problems and premises see the May/June, and July/August issues of the Journal of Rehabilitation. See also (Lubin, 1976) for a newspaper account of some corporation responses to the law. An interesting and informative spin off from the Congressional mandate to address the problems of the severely disabled is manifest in (Mallik, et al., 1975).

A document which should be of importance to the substance of this paper (I have not yet personally had an opportunity to read it) is the "Comprehensive Service Needs Study for the Most Severely Handicapped." This study was mandated by Title I, Part D of PL 93-112, and was to be completed by February 1975.

The Negative Image of Homework

Many rehabilitation professionals have deep and profound concern at the psychological damage done to homebound persons by carrying out rehabilitation service, including employment in the homes of the disabled.

Illustrative of this view is the following statement from (Rusalem and Cohen, 1975):

> The experience deprivation suffered by many homebound individuals effectively reduces their levels of intellectual, social, and vocational functioning to such an extent that, if left unchecked, this deprivation will result in irreversible psychosocial consequences that render the person unresponsive to almost any rehabilitation intervention, . . . as a desperate last resort, homebound service is better than no service--but infinitely less desirable than service provided outside the home.

This view sees the lack of suitable transportation, architectural and attitudinal barriers, and other institutional factors as major causes of homeboundedness in the United States. These causes should be removed and only as a last resort should homebound remunerative employment be used as a temporary vehicle to foster feelings of self worth and a heightened awareness of employment potential.

No one can disagree with the importance of enabling human beings, whether able or disabled, to have opportunities for social interaction--but there is a trade-off function to be considered here. One could ask under present circumstances, how effectively present rehabilitation practices and policies actually do create a meaningful and healthy social involvement for the severely disabled. One could also ask whether or not some psychological benefit to his class of persons might not derive from a sense of participation in gainful employment in an information job--a job in which the handicapped at least had electronic communication with others. One could argue that, given a job (in our society which still tends to value persons in terms of their work) the homebound handicapped might gain sufficient psychological strength (and some economic wherewith-all) to find ways to achieve more live human contact than would be the case without a job. Examples of such experiences have been reported by (Shworles, 1974; and GW, 1973). Given a job, the handicapped person did in fact increase his human contact. A sense of worth and some extra dollars actually produced greater mobility. The dollars helped in overcoming the high cost of travel for the handicapped.

Recent telephone and mail communication with a disabled young lady in Chicago (Zima, 1976) reinforces several of the above comments. This 24-year-old woman, valedictorian of her high school class with a bachelor's degree in education, achieves mobility with an electric wheelchair but is dependent on others for assistance with most activities of daily living. Unable to secure a teaching job she finally located a homebound clerk typist job which included telephone contacts with coworkers. Her job was part of a City Colleges of Chicago Illinois Division of Vocational Rehabilitation research project, directed by Tom Shworles, to train and seek information jobs for handicapped persons. Her job duties included the following: (a) typing service for project staff, (b) design and maintain a filing system for project materials, (c) maintain a communication system among staff members and consultants, (d) coordinate project meetings,

(e) compose and type purchase orders and justification memos for supplies and services, (f) maintain up-to-date accounting balances for line items in the project budget, (g) make all travel arrangements for project staff, (h) interviewing potential clients for the testing of curriculum packages, (i) develop charts, graphs, etc. to summarize curriculum data being collected, (j) obtain bids on curriculum packages and equipment recommendations by project staff, and (k) compose some correspondence and routine reports. Her job required that she work approximately one day every two weeks at the downtown office.

After several months of this kind of homebound work including a trial period, she was able to arrange living circumstances so as to be able to take a full time job in the downtown office. Her first reaction to the homebound clerk typist job was one of some apprehension at the lack of socialization. Her fear turned out to be unfounded as she said:

> I do not know if I should attribute it to the outgoing and understanding individuals working in the CPDH office or simply to the type of work I was doing, but I felt that between my bi-weekly visits to the office and my contacts with individuals via telephone I had just enough involvement to satisfy my need for socialization.

Ms. Zima did indicate that she never looked at the homebound clerk typist job as an end in itself but rather as a means to a full time regular job in complete articulation with the rest of the world of work. She cited several positive factors in her experience with the homebound job: (a) it helped by giving a goal and purpose, (b) it allowed experimentation in non-traditional methods of becoming more physically productive, (c) it helped produce a sense of personal confidence in one's ability, and (d) it provided some income which could be used to purchase services and equipment which could help in achieving independence and possibly non-homebound work.

Reflecting on this negative image of homework one might design some human factors experiments to explore several dimensions of the psychological impact on persons so employed. One might argue that information handling jobs are a different class of work than that which is customarily considered "homebound work." Traditional homebound jobs for disabled persons where they sew or make things in their homes for sale in rehabilitation outlet stores etc. tend to be inherently lacking in communication with the outside world. We might label these jobs as "communication poor." Information handling jobs using a telephone, telefacsimile devices, and/or a computer terminal tend to require more interaction with the work process. These jobs might be called "communication rich."

Given experimental groups working at each kind of job, communication poor and rich, could we not use our psychology and human factors expertise to assess the attitudes and perceptions of each group toward their jobs and life styles? Perhaps a study of this type might also be designed to include another factor--the degree of permanence of the homebound situation. For some very severely disabled homebound persons,

employment might be the end goal, for others it might be viewed as a temporary means to non-homebound work. Would this differentiation produce significantly different attitudes and perceptions?

In view of these widely shared concerns as to the damaging impact of isolation arising out of homeboundedness, our primary focus should be on remote work as a temporary means to non-homebound employments. Certainly we should not assume some kind of a technological imperative--just because something is technologically possible is by no means a justification for implementing it. Indeed as (Weizenbaum, 1976) implores, there may well be moral and ethical reasons for not doing certain things with computers and computer systems. On the other hand we might ask what is sacrosanct about producing human contacts through the vehicle of seven or eight hours of work in a central office facility. Conceivably different and even more healthy patterns of human articulation might develop if we experiment with new work arrangements. Some such experimentation is suggested in the quality of working life issues dealt with in (Davis & Cherns, 1975).

As an aside, for an insightful dystopian science fiction portrayal of a society of the future in which personal human interaction no longer exists because of developments in communications technology, see (Forster, 1963). It is interesting that this story was written in 1928.

Some Additional Socio-Technical Trends of Significance to Human Factors Professionals Interested in Bringing Jobs to Disabled Persons

A brief overview of the transportation-communication tradeoff situation, an introduction to PL 93-112, and some considerations on the negative image of homework have been presented. We have seen how the 1973 law has stimulated interest in employment options for the severely disabled which in turn increases the demand for human factors contributions in matching sensory, motor, decision-making capabilities of disabled persons to work system requirements. Several other trends should be mentioned as worthy of consideration as potential avenues for involvement by human factors and engineering psychologists. Two such trends are: state legislative and administrative activity and the general societal trend of citizen participation and consumerism.

In addition to the federal law many states have recently enacted legislation changing the legal environment relative to the handicapped. For example, the Governor of Ohio signed into law Amended Substitute Senate Bill No. 162 in April 1976. This law modified state proceedings to prohibit discrimination against the handicapped in housing and employment in certain instances. In circumstances addressed by the law, it is now illegal to discriminate against persons for reasons of race, color, religion, sex, national origin or ancestry, and handicap. The implications of this and similar legislation in other states needs to be assessed relative to the topic of this paper.

Changes seem to be occurring in relationships between Workmen's Compensation and rehabilitation which might also be examined relative to new possibilities for employment of occupationally disabled persons. James Rhodes, Governor of Ohio, in a cover letter to the April 1976 issue of Monitor (Rhodes, 1976), stated that in addition to the present functions of the Ohio Bureau of Workmen's Compensation, "Now, the important new dimension of REHABILITATION is being added." Since it had always been my impression that rehabilitation and retraining for new job skills was an intimate part of Workmen's Compensation, I find it interesting to ask, 'What is new?' Does this new dimension of W.C. suggest possibilities for taking some jobs to disabled persons in ways that might not have been considered before? I am presently seeking clarification on this issue.

In recent years there has been a noticeable rise in consumerism and citizen participation in both public and private institutions. Ralph Nader in his consumer advocacy activities and that of the environmentalists has undoubtedly been a driving function for much of this activity. Albert Hirschman, an economist, in his very insightful book (Hirschman, 1970) tries to understand why people seem more and more inclined to, in his words, "exercise more voice and less exit" in their relationships with both public and private institutions. Lind (Lind, 1975), a political scientist, explores the phenomenon of citizen involvement. If the consumer and citizen participation movements represent a long-term trend and not just a momentary oscillation, then they carry implications relative to our interest in taking jobs to people. In our experiments and deliberations on human factors in employments for handicapped persons we will find it increasingly necessary to more meaningfully include the disabled in all aspects of our undertakings. Indeed, activists like Maggie Kuhn (The Gray Panthers) and similar groups representing the disabled are already making impacts in these directions. In my own view this is a healthy phenomenon which can lead to more effective solutions.

Job Identification

A major area where human factors persons (especially those familiar with the latest kinds of computer-telecommunications technology and related work systems) can make a contribution is in helping to identify potential jobs that can be taken to people. The Dictionary of Occupational Titles is inappropriate as a source of information of this kind. Needed is a concentrated study, perhaps multi-disciplinary (including human factors types, industrial engineers, electrical engineers biomedical rehabilitation engineers, computer scientists, communication specialists, medical rehabilitation specialists and rehabilitation professionals) in which classes and types of present and not distant future information handling tasks and jobs suitable for remote accomplishment are identified and located. Tom Shworles' and colleagues at the Center for Program Development and the Handicapped, City Colleges of Chicago are attempting to address this problem but they are not finding it an easy task.

Since I presently know of no such multidisciplinary job identification task force let's start one right now. If each of you who hears this presentation or reads this paper would sit down for a couple of hours and identify an information handling job which could be performed remotely to some central office facility, and send this information to me, I will start a new dictionary of information jobs of value in this field. In doing so you should identify the necessary items of technology, task details and importantly, you should keep in mind how the job as it presently exists may have to be restructured to permit its remote accomplishment by some handicapped person. It might help too if you do this with some specific disability in mind.

Our professional and existential mental sets create difficulties for us in doing what I have suggested above. In industrial engineering job design terminology we might speak of "fictitious restrictions"--restrictions built into the job design which we assume (but which are not true constraints) because of our overwhelming familiarity with "the way things are done." We need some creative imagination coupled with good hard and sound professional and technical competencies in looking at new ways to organize our work patterns. For example, in thinking about a blind typist we might be inclined to rule out this kind of a job because we could see no way for this blind person to detect and correct typing errors. Possibly this constraint might be fictitious if we could conceive of a restructured job or a modified division of labor in which some sighted person proofed the typed material.

Back to this idea of information handling job identification--there are several ways in which this task might be approached. We might identify these jobs by looking at institutions such as banks, insurance companies, government offices, etc. which are essentially groups of people huddled around computers. Keeping in mind the idea of "fictitious restrictions" we should have little difficulty in identifying several prime job candidates. Some years ago I visited the home offices of a small insurance company that sold its policies by direct mail and maintained much contact with its policy holders via in and out WATS telephone lines. Seated in one large room in front of CRT computer input-output terminals were several women answering potential customer and policy holder questions over the phone. Policy holder information was stored in the computer and accessible to these women through their individual terminal. A cursory discussion indicated that about 80 percent of the work activity of the terminal operators took place at their desk in interaction with customers and policy holders via the telephone and terminal. Some job redesign with a different division of labor might well enable large components of these kinds of jobs to be located outside that central office.

Another visit to a Blue Shield office impressed me with similar possibilities in several of the record handling tasks I observed. In an investigation in a government office (Joe Cala, 1974) (graduate student in Industrial and Systems Engineering at Ohio University) worked with interested persons in the State of Ohio Rehabilitation Services Commission

(RSC) to explore the feasibility of relocating an IBM 3275 cathode-ray tube data entry computer filing job. The State of Ohio RSC maintains an office force some ten miles away from the computer where client records are maintained. With a large client population (persons around the entire State who are being worked with by RSC) records need to be updated as client's status change. Presently an office force of three women perform the updating task by interacting with an IBM 3275 CRT terminal device. This job was studied to identify those elements which might be the least time dependent and capable of being remotely located. An elementary economic feasibility study was accomplished for one homebound handicapped person to carry out a portion of this records keeping task with a terminal in his home. Conclusions: It is technically, organizationally, and economically feasible to locate such a vocational prostheses device in a homebound's home. Rough estimates indicate that earnings by the handicapped person would pay back all purchase and installation costs in about 2½ years.

In our job identification task we could examine trends in information activities such as the exponential growth in both in and out WATS telephone usage and ask how this phenomenon suggests new kinds of remote information jobs for disabled persons. I have made a feeble attempt to acquire data from the Bell System and AT & T on WATS developments but have not yet been successful. Another possibility might be to go to the Federal Communications Commission for data. There are apparently some confidentiality constraints involved in divulging this material.

Job identification could proceed by looking at specific pieces of technology and the integration of that technology in work systems. Likely candidates are the computer, telefacsimile devices, cable television and "word processing" technology.

(Desautels, 1973) specifically addresses himself to several possibilities inherent in computers and computer technology for the physically disabled. His paper is ". . . directed towards identifying some of the needs of the physically disabled, some of the services computers and computer related technology currently provide them, potential new services, and recommendations on the design of computer systems and computer-related devices."

Murray Turoff (1975) explores the idea of computer conferencing and suggests several possibilities for its use to enhance the life style and employment options for disabled persons. Deaf persons have in the past established communications networks between themselves using old teletype systems. Computer conferencing networks are tremendously more powerful extensions of these deaf networks. Writing on a related topic, Myer, coauthor in (Overby, Myer, Hutchison and Wiercinski, 1977) says:

> With regard to communication, some recent work in computer technology bears mention and investigation for its possible value to the handicapped. The development of time shared computers and data communication technology made it possible for many individuals to

simultaneously carry on programming, data entry, text manipulation, and other tasks, often at some distance from the supporting computer. However, little if any provision existed within the computer system for communication among its simultaneous users.

All that has changed recently with the development of computer programs that support direct interpersonal communication, via messages, between the users of a single computer or of separate computers interconnected by a network (Myer, 1974; Myers & Dodds, 1976). A major early use for this technology is in the management and execution of projects involving collaboration among geographically dispersed individuals and groups. Management decisions can be disseminated through the message system; it can support "remote" conferences, planning sessions and the transmission of work produced. Although such communication has not replaced other media, its active users report a dramatic decrease in usage of the telephone, mail service, and even travel.

Message communication cannot completely replace face to face or voice to voice contact; too much richness of information transfer is lost when one relies solely on the written word. However, it certainly represents a dramatic new communications channel of possibly special value to the homebound handicapped.

Among its developers, computer message technology is often thought of as one stage in the development of an "automated" or "electronic" office--an office support system including file handling and text processing tools and other paraphernalia of office life, but all residing within a computer system (B.W., 1975). The trend toward such a capability cannot help but benefit the homebound, since physical proximity to office artifacts will diminish in importance as such artifacts are shifted into a remotely accessible computer system.

Another example of a technology specific vehicle to job identification is a presently ongoing mini-technology assessment of TOPS (Traffic Operator Position System). I presently have a small grant from Bell Northern to explore the feasibility of adapting this new piece of telephone operator technology for employment of disabled persons at locations remote from the central telephone office. TOPS is technically quite easily remotable. We are exploring job restructuring requirements, potential use of this system to meet peak telephone service demand periods and institutional interaction with various rehabilitation programs. Human factors considerations in adapting the technology to specific disability patterns will also be addressed.

Let me briefly conclude this section on Job Identification with a few remarks about telefacsimile devices, cable television and "word processing."

Telefacsimile devices are machines made to transmit hard copy via telephone lines. Perhaps in our identification of jobs we will need to interact more effectively with the Xerox Corporation, QWIP Systems (a

Division of Exxon Enterprises) and other manufacturers to discover more of the novel ways in which their customers are using these and related devices in their information handling tasks. Looking into the future a bit, perhaps some of us have access to the research and prototype equipment development areas of Xerox, Bell Labs, IBM, etc. so that we might be able to assess future information handling technology from the perspective of its implications for remote job location.

Cable television (CATV) suggests mind boggling possibilities for new patterns of work organization if in the words of (Balabanian, 1973) the promise can become reality. See (NSF, 1975) for a summary of recent NSF supported research in this area.

"Word processing" technology and systems need to be investigated. (Frame, 1975) describes this area as follows:

> Word processing can be described as a systematized process of putting ideas into typewritten form through a combination of people, procedures, and equipment. The major objective is to increase productivity by making one or more of the following changes:
> * Adding automated dictation equipment and/or automated text-editing typewriting equipment to increase the speed and accuracy with which ideas are gathered and transmitted into typewritten form.
> * Improving various office procedures such as filing, machine calculations, and telephone communications to expedite the flow of paperwork and improve cost-effectiveness.
> * Revamping the tasks and work relationships among office personnel to bring about a higher degree of specialization and efficiency.

Job Profiles Matching Disability Profiles

Another way in which human factors professionals might effectively contribute is through work on the creation of job profiles for the information jobs identified. Rehabilitation counselors in working with clients could use some help in matching information handling task requirements to specific disabilities and/or general classes of disability. Some effort is being expended in this area by Shworles and colleagues in Chicago but more thought, including unique inputs from human factors specialists, is needed.

As a first consideration here we might think of a continuum of disability ranging from normal (non-disabled) to the most severely impaired. Then perhaps we could subdivide this continuum into major categories of impairment. We could then relate this disability category scale to each job (information handling jobs in this instance) in such a way as to aid the rehabilitation counselor in matching individual persons' disabilities to job requirements. An important dimension of this "Job-Disability" matching device would be an identification of various job design changes and prosthetic adaptations required and available in moving from normal to severely disabled categories. Job accommodations can be of several varieties:

a. Rehabilitation engineering and prosthetic devices of the kind being developed at the Northwestern Rehabilitation Engineering Program (Childress et al., 1975; Pfrommer, 1975 and Compere & Childress, 1975). Specific contributions by human factors specialists in the human-machine interface area could enhance this work.

b. Changes in the design of the job itself which would be required to enable it to be performed remotely to some central organization. Are the time requirements flexible enough to be able to permit a lengthening of the time loop for performance and completion, etc.? Industrial engineering and human factors professional competencies are needed to assess the varieties of job modifications possible as a function of the disability continuum mentioned earlier.

c. Educational delivery systems modifications to permit remote training for the job, etc. Thus far no mention has been made in this paper of the problem of job skills acquisition by the disabled. Obviously here is an entire massive area of need to which the creative capabilities of human factors professionals are applicable. Some of these possibilities are being addressed by Shworles and colleges in Chicago and an interesting project on "Education Delivered to the Severely Disabled" is being run with Ohio Division of Vocational Rehabilitation funds under the direction of Lynn Rosen at Cuyahoga Community College in Cleveland. The entire area of computer-telecommunication technology and systems, ranging from computer aided instruction (CAI) to computer conferencing applications, to cable television (see NSF, 1975), to hosts of other audio-visual educational delivery systems, needs to be examined relative to taking jobs to the disabled.

d. Economic considerations and implications of varying degrees of prosthetic, human factors and job restructuring schemes should somehow be reflected in this "Job-Disability" matching device. How much would it cost to equip and train a disabled person to become employable? What might be some of the calculable savings in terms of reduced social welfare disability payments? What would the investment payback period be, etc.? Answers to questions such as these are very complex and get us into the public policy domain such as discussed by (Dicus, 1973 & 1974) and briefly reviewed in (Overby et al., 1974). Reflection on these economic considerations leads to the suggestion of another human factors type assessment. Given the various social welfare disability support systems under which the disabled sustain themselves, what are their perceptions as to the incentives and disincentives to seek to become gainfully employed and partially or fully self-supporting. How would various modifications in these economic disability support systems interact with disabled perceptions as to incentive or disincentive to employment?

A major problem in seeking to develop a device such as the "Job-Disability" matching scheme loosely outlined above, lies in the dynamicness of the technology systems. Prosthetic devices, educational delivery systems, and the information jobs themselves are rapidly changing in time. But if the idea has any merit, why not start with contemporary technological possibility and then develop appropriate updating mechanisms as things change in the future?

My suggestion that there is a need for something like a "Job-Disability" matching device is also related to the problem of technology transfer and diffusion. Rehabilitation professionals and counselors at the applications and realistic implementation end of the process are not intimately familiar with what is going on in places such as the Northwestern Rehabilitation Engineering Program, or with the efforts by Shworles' group in Chicago, etc. The connection between a multiplicity of research findings and some useful applications to the lives of individual persons is a very tenuous one. A "Job-Disability" matching device would attempt to aid in this technology transfer process. I am aware of interest within HEW in seeking to create some new and different institutional relationships which might enhance technology transfer.

Finally, before I leave this section of the paper let me get back to PL 93-112 again. The 1973 law requires that each state must maintain a written rehabilitation program for each handicapped individual served. For those persons determined to be ineligible, reasons for their ineligibility must be given. Section 102(b) of the law says that these individualized written rehabilitation programs " . . . shall include, but not be limited to (1) a statement of long-range rehabilitation goals for the individual and intermediate rehabilitation objectives related to the attainment of such goals, (2) a statement of the specific vocational rehabilitation services to be provided, (3) the projected date for the initiation and the anticipated duration of each such service, (4) objective criteria and an evaluation procedure and schedule for determining whether such objectives and goals are being achieved."

In view of the fact (to my knowledge) that human factors professionals (especially those with an interest and involvement with computers and telecommunications) have thus far had but limited formal contact with the rehabilitation process, the following exploration might be instructive and productive. If a sample of these individualized written rehabilitation programs and rejections could be obtained, without infringement on the privacy of individuals, an analysis by human factors specialists and engineers in cooperation with rehabilitation professionals might lead to outcomes which could be facilitative of the technology transfer process mentioned above.

Some Human Factors Specifics

In several places in this paper, reference has been made to ways in which human factors contributions could be made to enhance the possibility of bringing jobs to the disabled. Some of you might object that

there has been too much "other stuff" and not enough specific traditional human factors, human-machine interface suggestions. Partly this results from my perception, alluded to at the outset, that institutional factors loom first in importance relative to getting these ideas translated into realistic and helpful applications for the disabled. This lack of specific human factors "stuff" also reflects my perceptions (as a human factors professional myself) of the creative capability of human factors types. I know that you instinctively appreciate the hosts of new questions and research possibilities inherent in the human-machine interface domain when thinking of these systems in terms of the multiplicity of sensory, motor, and decision making constraints implied by the word "disabled." Basic human factors considerations can be found in (Bennett et al., 1963; DeGreene, 1970, and McCormick, 1976). The literature on sensory-motor aids and devices for the handicapped is voluminous. It is beyond the intent of this paper to get into this area. Illustrative of some of this literature are (Nye & Bliss, 1970; Goldish, and Dairymple). It is important that we be aware of the technology and systems that are available as aids to the disabled so that we might translate them into the job requirements picture. In this respect, considerations of employment possibilities for the severely disabled in information jobs should reflect the work described in the Childress paper (Childress et al., 1975) and the insights in (Pfrommer, 1975). Abstracts of these papers follow:

> Childress: "The design of small-scale, medium-scale, and large-scale communication and control systems for severely disabled persons is discussed. A "call" system (small-scale) and an environmental control system (medium-scale), both commercially available, are presented. Also presented is a medium-scale system for control of a business telephone. A large-scale system, computer-based, is described. These various systems are related by a unified design which permits great flexibility in their application."
>
> Pfrommer: "An account of a quadriplegic's experiences with assistive systems (mobile, environmental, and vocational) modified or developed by the Northwestern University Rehabilitation Engineering Staff. These systems are individually accomplishing the purpose for which each was developed. Used together they are producing synergistic effects both good and bad. This paper also stresses the importance of immediate feedback from the disabled to the engineering staff for purposes of improving engineering design."

Before concluding this paper I do wish to allude to some additional human factors issues specifically related to taking jobs to confined people, but first let me briefly elaborate on my earlier comment in this section of the paper on the importance of the institutional factor.

In an earlier paper (Overby et al., 1974) I listed several institutional factors which must be considered in bringing jobs to the disabled via computer-telecommunications technology. Some of these have been expanded in this paper, others have not been mentioned. Protective labor

legislation such as Workmen's Compensation, the Fair Labor Standards Act, the Occupational Safety and Health Act, various state laws regulating home work, etc. are all important institutional realities that need to be kept in mind. Similarly, managerial concern at loss of control with remotely located jobs, and labor union interest in the exploitive potential in homework are factors to be dealt with. There are human factors issues built into each of these if we examine them carefully.

In this paper also I have but scarcely alluded to another entire dimension of broad socio-institutional factors such as that manifest in the "Quality of Working Life" movement (Ebling, 1974; Davis and Cherns, 1975). Here also are human factors issues which relate to the bringing of jobs to confined persons. An entire paper should be devoted to this dimension alone.

One of the institutional constraints mentioned in my earlier paper was written before I was aware of the 1973 Rehabilitation Act, PL 93-112, and its affirmative action, equal employment opportunities content.

In 1974 I wrote:

> While many technical professionals in the computer-telecommunication area are sensitive to the needs of the handicapped, there are not sufficient rewards within their organizational structures for them to invest substantial amounts of time and energy in the area of computer-telecommunications vocational prostheses.

In 1976 it looks as if this institutional constraint has been modified. As the Wall Street Journal article (Lublin, 1976) indicates, "pressured companies decide the disabled can handle more jobs." Whether we agree or not as to the means by which this change has come about, it seems a fact that engineers, human factors professionals, and others might find their employers more receptive and the reward structure improved if they should wish to apply some of the creative talent in finding new ways to bring jobs to the disabled or to accommodate jobs for handicapped persons.

Communications Studies and Human Factors

We have looked at several dimensions of the problem of bringing jobs to the disabled and at various human factors issues. Earlier I suggested a need to explore more scientifically than has been done to date, the attitudes of disabled persons in homework situations in terms of "communication rich" and "communication poor" types of homework. These ideas lead to a more general class of studies.

Some of the interactive computer systems concepts referenced earlier (Myer et al., 1976 and Turoff, 1975) implicitly contain the seeds of a multiplicity of human factors studies, for both the able bodied and disabled. In considering how to take interactive computer-telecommunications jobs to disabled persons we need to know considerably more about how

persons communicate with one another in various kinds of job and task situations in interaction with all kinds of arrangements and configurations of equipment and devices. Add another variable, that of disability characteristic and it is possible to conceive of a great many experimental studies which could be productive for our interest in taking jobs to the disabled. (Chapanis et al., 1972) reports a very interesting and suggestive study in which he explores two kinds of problem solving tasks with four different modes of communication. The work of Chapanis "Investigation of Human Factors in Teleconferencing" reported in (NSF, 1975) should also suggest human factors research questions and possible applications in bringing jobs to the disabled.

(Reid, 1971) in an early paper dealing with transportation communication tradeoff issues deplores the lack of research attention by colleges and universities of the human factors and social psychological implications of telecommunications technology. He suggests a need for research in four broad areas:

1. There is a need to know more about existing patterns of communication. What are the kinds and relative importance of "contacts" between persons in carrying out their functions?

2. Objective field trials of new telecommunications devices such as the Picturephone® and "Confravision" need to be carried out.

3. Controlled laboratory research is needed where the effects of various communication media on communication behavior can be assessed and studied while persons are engaged in different communication tasks.

4. There is need--to construct mathematical models of the interaction between location patterns, travel patterns and tele-communication technology.

Expanding on some of the areas suggested by Reid (Champness, 1973) examines persons' attitudes toward three different media (face-to-face, loudspeaking audio, and closed circuit television) in carrying out a two-person choice dilemma task requiring a joint decision. Studies such as these and many others carried on by the Communications Studies Group, University College, London are suggestive of possible human factors explorations related to bringing jobs to homebound persons.

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